Old School Proximity Sensor Implementation

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Most inductive proximity sensors have a set of standardized behaviors and a designer's understanding of these behaviors can lead to successful implementation while avoiding the pitfalls typically associated with these sensors.

How it works

Inductive proximity sensors generate a magnetic field from their detection faces. Whenever a detectable object moves into the sensor's field of detection, Eddy currents build up in the target and dampen the sensor's magnetic field. This effect triggers the sensor's output. Since a current in the target is needed for detection, inductive proximity sensors are uniquely suited for detection of all types of metals.

Inductive proximity sensors come in two forms, shielded and unshielded. A shielded inductive proximity sensor can be embedded flush in its mounting material without affecting the sensor's field of detection. The unshielded inductive proximity sensor has the advantage of longer sensing distances, but the disadvantage of not being embeddable.

What happened to my sensing distance?

When an inductive proximity sensor is rated for sensing distance, it refers to the sensor's ability to detect the "standard detectable object" at its specified sensing distance. The "standard detectable object" is a 1mm thick square piece of ferrous iron that is in height and width the size of the proximity sensor's detection face's diameter.

If the target material that you are detecting is not a ferrous iron, you can expect the effective sensing distance of the sensor to be different. Here are a few examples of the reduction in sensing distance due to target material. Copper is 30% of the effective sensing distance, aluminum is 40% effective, brass is 50% effective, and stainless steel is 80% effective.

Other factors that can account for reduced sensing distances are the target material's capacity for conductance. Conductive materials disperse the Eddy currents that are required for inductive sensing. Highly conductive materials make poor detectable objects and create reduced sensing distances. On the other hand, thin materials, for example aluminum foil, hold the Eddy currents and make excellent targets for inductive sensing.

Lastly, make sure that you are using the inductive sensor under the specified power requirements. Reduced line voltages can lead to weak magnetic fields from the sensor's detection face and consequentially, smaller sensing distances.

Why is my output chattering?

Inductive proximity sensors are designed to have a type of hysteresis in their circuitry that is used to eliminate output chattering. As a target approaches the sensor's detection face, it eventually triggers an output on the sensor. When the target moves away from the sensor's detection face, the triggered output holds until a certain distance has been passed.

This distance is called the "reset distance" or "distance differential" and can be as high as 10% of the sensor's total sensing distance. This holds proportionally true for detection objects that cause reduced sensing distances. Make sure that the target object is completely removed beyond the sensor's reset distance to avoid all potential chattering due to detectable object vibrations or other environmental factors.

When using a multitude of inductive proximity sensors in an application, one must be aware of an effect called mutual interference. This occurs when one proximity sensor's magnetic field effects another sensor's magnetic field causing it to trigger an output. This false triggering can be erratic and difficult to detect.

The safe mounting distances of multiple inductive proximity sensors are defined in its manufacturer's specifications. Typically, side by side mounting is roughly twice the diameter of the sensor's sensing face. If you are required to mount the sensors closer than allowed in specifications, there are a few tricks to avoid mutual interference.

Look for inductive proximity sensors that feature alternate frequency models. These alternate frequency sensors oscillate their magnetic fields in different frequencies and do not interfere with one another as much as two inductive proximity sensors with the same frequency do. Simply take one frequency proximity sensor and mount it next to one of a different frequency.

Another option for mutual interference avoidance is to multiplex inductive proximity sensors that are close together. By turning the sensors on and off in rapid succession, one can still perform detection while ensuring that the closely mounted sensors do not false trigger one another. The downside is that the sensor's response times will become longer.

Inductive proximity sensors are a simple and effective sensing tool. Avoid application problems by planned implementations and your applications will be a success.

Caption

A standard 30mm diameter inductive proximity sensor has a 10mm sensing distance. The above chart shows the reduction in sensing distance due to different types of materials.

Biography

Guerrino is a proximity sensors product marketing specialist Omron Electronics LLC. He is a graduate in Electrical Engineering from the University of Illinois at Urbana-Champaign. While there, he studied Quantum Electronics and Wave Theory.

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